DOCUMENT RESUME

ED 191 210 EC 124 571

AUTHOR Tarver, Sara G.; Ellsworth, Patricia S.
TITLE The Effects of Stimulus Presentation Rate on the Short-Term Memory of Learning Disabled Children.
INSTITUTION Wisconsin Univ., Madison. Research and Development Center for Individualized Schooling.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.
REPORT NO WRDCIS-TR-536
PUB DATE Apr 80
GRANT OB NIE-G-80-0117
NOTE 3?p.: For related information, see EC 114 145 and ED 169 6?3.

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Elementary Education: Exceptional Child Research: *Learning Disabilities: *Memory: Recall (Psychology): *Time Factors (Learning)
IDENTIFIERS *Rehearsal

ABSTRACT

To test the hypothesis that the developmental lag in verbal rehearsal which has been documented for the learning disabled is due to a naming speed deficit (i.e., slow retrieval of stimulus names), the serial recall performance of 64 learning disabled children at four grade levels (1, 3, 5, and 7) was compared under three stimulus presentation conditions: a standard 2 second (2S) presentation rate which served as a control condition, a slower 6 second (6S) presentation rate, and a subject controlled (SC) variable stimulus exposure time. It was hypothesized that the 6S and SC conditions would facilitate the use of verbal rehearsal (as reflected in improved primacy recall) by allowing more time for retrieval and rehearsal of the names of the stimulus items (animal pictures). As predicted, the three stimulus presentation conditions affected primacy recall differently: SC produced the greatest primacy: 6S produced the greatest recency in combination with moderate primacy: 2S produced a recency, but no primacy, effect. In general, findings indicated that, for the learning disabled: slow naming of stimulus items contributes to deficient verbal rehearsal under rapid stimulus presentation rates, the experimental provision of additional time to retrieve and rehearse the stimulus names facilitates verbal rehearsal, and developmental increases in speed of naming precede developmental increases in the use of efficient verbal rehearsal strategies. (Author/SBH)

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Technical Report No. 536

THE EFFECTS OF STIMULUS PRESENTATION RATE ON THE SHORT-TERM MEMORY OF LEARNING DISABLED CHILDREN

by

Sara G. Tarver and Patricia S. Ellsworth

Report from the Center Royalty Fund Committee

Sara G. Tarver
Faculty Associate

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The University of Wisconsin
Madison, Wisconsin

April 1980

EC124571

MAY 27 1980

Published by the Wisconsin Research and Development Center for Individualized Schooling. The project presented or reported herein was performed pursuant to a grant from the National Institute of Education, Department of Health, Education, and Welfare. However, the opinions expressed herein do not necessarily reflect the position or policy of the National Institute of Education, and no official endorsement by the National Institute of Education should be inferred.

Center Grant No. OB-NIE-G-80-0117

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The Wisconsin Research and Development Center is supported with funds from the National Institute of Education and the University of Wisconsin.

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Abstract

To test the hypothesis that the developmental lag in verbal rehearsal which has been documented for the learning disabled is due to a naming speed deficit (i.e., slow retrieval of stimulus names), the serial recall performance of learning disabled children at four grade levels (1, 3, 5, and 7) was compared under three stimulus presentation conditions: (a) a standard 2-second (2S) presentation rate which served as a control condition, (b) a slower 6-second (6S) presentation rate, and (c) a subject-controlled (SC) variable stimulus exposure time. It was hypothesized that the 6S and SC conditions would facilitate the use of verbal rehearsal (as reflected in improved primacy recall) by allowing more time for retrieval and rehearsal of the names of the stimulus items (animal pictures). As predicted, the three stimulus presentation conditions affected primacy and recency recall differently: SC produced the greatest primary; 6S produced the greatest recency in combination with moderate primacy; 2S produced a recency, but no primacy, effect. Serial recall improved across grade levels; furthermore, a supplementary analysis of naming speed showed that first graders required more time to name the animal pictures than did the older subjects. In general, the findings indicate that, for the learning disabled: (a) slow naming of stimulus items contributes to deficient verbal rehearsal under rapid stimulus presentation rates, (b) the experimental provision of additional time

to retrieve and rehearse the stimulus names facilitates verbal rehearsal, and (c) developmental increases in speed of naming precede developmental increases in the use of efficient verbal rehearsal strategies.

Investigations of the short-term memory problems of learning disabled children have consistently shown them to be deficient in the production and/or use of verbal rehearsal strategies which underlie the recall of primacy items on serial recall tasks (Bauer, 1977a,b; Pelham & Ross, 1977; Swanson, 1977; Tarver, Hallahan, Kauffman, & Ball, 1976; Torgeson & Goldman, 1977). The fact that primacy recall increases with age in the learning disabled, as it does in nondisabled children, suggests a developmental lag, rather than a permanent deficit, in this aspect of information processing (Dawson, Hallahan, Reeve, & Ball, 1979; Pelham & Ross, 1977; Tarver et al., 1976).

Among the language deficits documented for learning disabled children are (a) word finding or word retrieval problems (German, 1979; Wiig & Semel, 1975), (b) slow performance on a variety of verbal, relative to nonverbal, tasks (McGrady & Olson, 1970), and (c) inferior performance on a variety of tasks requiring rapid, automatic naming (Denckla & Rudel, 1976). These findings are consistent with long-standing clinical reports of "dysnomia" (i.e., a condition characterized by difficulty in recalling the names of objects) in learning disabled children. More recently, such problems have been conceptualized as slow access to the linguistic or semantic store.

A naming speed deficit, manifested as failure to label quickly the stimuli used in serial recall tasks, could account for the deficient cumulative verbal rehearsal of the learning disabled. Rapid

labeling is essential to the cumulative rehearsal of those labels. Chi (1977) contends that naming speed plays an important role in the normal development of memory span. He found that adults were superior to children in speed of initial information processing (i.e., name retrieval and encoding) and concluded that these encoding processes are prerequisite to the application of mnemonic strategies such as cumulative verbal rehearsal. If naming speed contributes to normal developmental increases in short-term memory, it is reasonable to hypothesize that a deficit in naming speed contributes to the developmental lag in short-term memory exhibited by the learning disabled.

Slowness of labeling stimuli would likely have a more detrimental effect upon serial recall under rapid stimulus presentation rates. Slower presentation rates should facilitate primacy recall by allowing more time for retrieval and rehearsal of the names of the stimulus items. Detterman (1974) found this to be the case with mentally retarded children; a verbal rehearsal deficit was found under a 2-second presentation rate but not under 6- and 8-second rates. Presentation rates should affect primacy and recency recall differently; primacy is a function of verbal rehearsal, whereas recency is a function of an echoic-like perceptual trace. While recency recall may be facilitated by simple verbal labeling, it does not involve the type of cumulative verbal rehearsal that facilitates primacy recall (Ellis, 1970).

The purpose of the study reported here was to investigate the effect of stimulus presentation rate on the serial recall of learning disabled children. This was accomplished by comparing serial recall performance under three stimulus presentation rates [a standard 2-second rate (2S), a 6-second rate (6S), and a subject-controlled, variable stimulus exposure time (SC)]. The experimental provision of longer stimulus exposures and/or slower stimulus presentation rates does not necessarily assure, however, that subjects will use the additional time to retrieve and rehearse stimulus names (Naus, Ornstein, & Aivano, 1977). Therefore, additional information about the relationship between naming speed and serial recall was accomplished in this study by analyses of (a) an independent measure of naming speed obtained prior to test trials, and (b) stimulus exposure times in the subject-controlled condition. As demonstrated by Belmont and Butterfield (1971; Butterfield & Belmont, 1972), efficient use of cumulative verbal rehearsal in the subject-controlled condition should be evidenced by increasingly longer stimulus exposures across the primacy and middle, but not the recency, positions.

Two major hypotheses were formulated: (a) Both a slower stimulus presentation rate (6S as compared to 2S) and a subject-controlled stimulus exposure condition (SC) will facilitate the use of verbal rehearsal and thereby result in increased primacy recall, and (b) with increasing age, the SC condition, relative to the 6S condition, will

become more facilitative of primacy recall, reflecting developmental increases in ability to match individual speed of labeling with stimulus exposure time.

Because there is some evidence of sex differences in verbal encoding strategies (Kail & Seigel, 1977; Naus et al., 1977), equal numbers of males and females were included in this study and sex was treated as an independent variable.

Method

Subjects

A total of 64 learning disabled children participated as subjects--8 males and 8 females at each of 4 grades (1, 3, 5, and 7). Each group of 8 contained 1 black and 7 white subjects. All subjects had previously been identified as learning disabled by school personnel and had scored an IQ of 85 or above on an individually administered standardized intelligence test.

Subjects at grades 3, 5, and 7 also met the criterion of a discrepancy between reading achievement and reading expectancy. This reading discrepancy was computed by taking the child's grade level score on a standardized reading test and subtracting it from his or her expected reading grade level score [computed as MA minus 5.0 (Dunn, 1963)] at the date of administration of the reading test. Because this study was conducted during October and November of the

school year, the first grade children had not been in school long enough for a significant discrepancy to develop; thus, a selection criterion of documented difficulties in pre-reading skills was imposed in substitution for the reading discrepancy criterion at the older age levels.

T-test comparisons of male and female groups at each of the four grade levels revealed no significant differences ($\sigma = .05$) in IQ, chronological age (CA), or reading discrepancy (RD). The following descriptive statistics were thus collapsed across sex: (a) Grade 1--$\bar{X}$ IQ = 105.0, range = 85 to 145; $\bar{X}$ CA = 6.5 years, range = 6.0 to 6.8 years; (b) Grade 3--$\bar{X}$ IQ = 110.3, range 99 to 129; $\bar{X}$ CA = 8.2 years, range 7.8 to 8.8 years; $\bar{X}$ RD = 1.1 years, range = .5 to 2.1 years; (c) Grade 5--$\bar{X}$ IQ = 100.6, range = 86 to 115; $\bar{X}$ CA = 10.4 years, range = 9.9 to 10.8 years; $\bar{X}$ RD = 2.0 years, range = .6 to 3.8 years; (d) Grade 7--$\bar{X}$ IQ = 93.7, range = 86 to 105; $\bar{X}$ CA = 12.1 years, range = 11.7 to 12.7 years; $\bar{X}$ RD = 2.2 years, range = 1.3 to 3.4 years.

Tasks and Procedures

A modified version of Hagen's (1967) central-incidental task was administered individually to each subject in a single session of approximately 30 minutes. The central phase of this task is a problem-type serial memory task which utilizes line drawings of animals and objects as stimulus items. In this study, seven animals and seven

objects (identical to those devised by Hagen) were paired such that (a) an animal picture was on the top half and an object picture on the lower half of each stimulus item, and (b) animal-object pairs remained constant, i.e., monkey was always paired with book, cat with lamp, bird with cup, etc. Animals were the central stimuli, objects the incidental; thus, subjects were instructed to attend to the animals only. Probe items contained animal pictures only.

A measure of naming speed was obtained at the beginning of the experimental session, prior to test instructions. All of the animal pictures were exposed simultaneously in a horizontal row and the subject was asked to name the animals, from left to right, as quickly as he or she could. Time required to name the animals was recorded to the nearest half-second.

Twenty-one central test trials were administered via an apparatus consisting of a subject console, an automatic slide projector, and a computer. The subject console, placed on a table in an upright position in front of the subject, contained a horizontal row of seven plexiglass windows (approximately 5" x 2-1/2" each with a 1" space between the windows) and an eighth probe window mounted above and in the center of the seven-window row. The stimulus items were projected into the windows by an automatic slide projector controlled by the computer. Items were exposed one at a time, from left to right. Following presentation of the seventh item of each trial, the probe

item appeared in the window above the horizontal row and the subject was required to press the window in which the animal identical to the probe had appeared on that trial.

The 21 test trials were divided into 3 blocks of 7 trials--1 block administered under the standard 2-second condition (2S), 1 block administered under a 6-second condition (6S), and 1 block administered under a subject-controlled condition (SC). Order of presentation of the three blocks was randomized. Prior to the test trials, three practice trials were administered in which the subject was shown some animals for a "short time" (i.e., 2S), some for a "longer time" (i.e., 6S), and some for as long as he or she wished to see them (i.e., SC). In the SC condition, the subject was instructed to view the picture in window #1 (i.e., position 1) as long as he or she wished and to press the window when finished. Pressing the window activated a switch which advanced the slide projector to the next item. The subject then viewed that item in window #2 until finished, pressed that window, and so on. Order of presentation of the seven pairs within each trial was randomized, with the restrictions that each of the seven animal pictures and each of the seven serial positions was probed once during each block of seven trials.

The computer was programmed to record (a) each response as correct or incorrect, (b) the serial position of each response, and (c) exposure times (to the nearest millisecond) for each of the stimulus items in the SC condition.

Although incidental recall was not a variable of primary importance to this study, the incidental phase of Hagen's task was administered. Immediately following completion of the 21 central test trials, all seven animal pictures were exposed simultaneously and continuously in the horizontal row of seven windows. The seven object pcitures were then exposed one at a time through the probe window and the subject was asked to match each of the objects with the animal picture with which it had appeared during the test trials. Unlike the standard administration, this procedure allowed the subject to match an animal with more than one object.

Results

Serial Recall Analyses

Serial recall scores were derived from the central recall phase of Hagen's task. Proportion of correct responses at each serial position was computed using a response bias (i.e., position preference) correction procedure which expresses correct first choices as a proportion of total choice frequency at that position (Donaldson & Strang, 1969). The arc sine transformation of this proportion was analyzed in a four-way analysis of variance (grade X sex X condition X position) with repeated measures for the condition and position factors. Table 1 reports the grade, condition, and position means (collapsed across sex because no sex main effects or interactions were found.)

Table 1

Mean Proportion (Arc Sine Transformation) of Correct Central Responses at Seven Serial Positions Under Three Conditions [subject-controlled (SC); 2-second (2S); 6-second (6S)] at Four Grades (1, 3, 5, 7)

Condition	Serial Position							Across Positions
	1	2	3	4	5	6	7	
Grade 1								
SC	68	22	32	69	51	42	174	65
2S	51	32	61	81	80	32	131	67
6S	99	39	126	52	20	87	184	87
Across Conditions	73	31	73	67	50	54	163	73[a]
Grade 3								
SC	164	30	51	87	109	119	212	110
2S	138	70	109	49	22	78	232	100
6S	147	80	80	66	68	99	263	115
Across Conditions	150	60	80	67	66	99	235	108[a]
Grade 5								
SC	167	49	78	51	49	124	215	105
2S	90	70	102	47	56	125	213	100
6S	128	67	58	124	61	47	311	114
Across Conditions	128	62	79	74	55	99	246	106[a]

Table 1 (continued)

Condition	Serial Position 1	2	3	4	5	6	7	Across Positions
Grade 7								
SC	205	99	128	80	59	119	215	129
2S	77	66	138	97	51	116	273	117
6S	109	109	64	59	55	128	273	114
Across Conditions	130	91	110	78	55	121	253	120[a]
Serial Position Across Conditions and Grades	120	61	85	72	57	93	224	102

[a]Grade across conditions and positions.

Note. Condition across grades and positions: SC = 102; 2S = 96; 6S = 107.

Significant main effects were found for position [F (6,336) = 45.54, $p < .001$] and grade [F (3,56) = 3.86, $p < .05$]. Results of the Scheffe post hoc procedure ($\sigma = .05$) supported the following: (a) Recall at position 7 was greater than that at each of the other 6 positions; recall at position 1 was greater than that at positions 2, 4, and 5 although not significantly greater than at position 3; recall at positions 2, 3, 4, 5, and 6 did not differ significantly. This position effect demonstrates both a primacy and a recency effect, i.e., better recall at the first and last positions than at the middle positions. (b) Central recall was greater at grade 7 than at grade 1. Although this difference between the two extreme grades was the only significant difference detected by the conservative Scheffe procedure, it should be noted that the greatest increase in central recall occurred between grades 1 and 3. The means for grades 1, 3, 5, and 7 were 73, 108, 106, and 120, respectively.

A significant condition X position interaction [F (12,672) = 1.94, $p < .05$] is depicted in Figure 1. As predicted, the SC condition, relative to both the 2S and the 6S conditions, facilitated primacy, but not recency recall. The 6S condition, relative to the 2S condition, facilitated both primacy and recency recall; however, it facilitated the latter to a greater extent than the former. The serial position curve most like the normal adult curve (i.e., a curve with a primacy slope almost as steep as the recency slope)

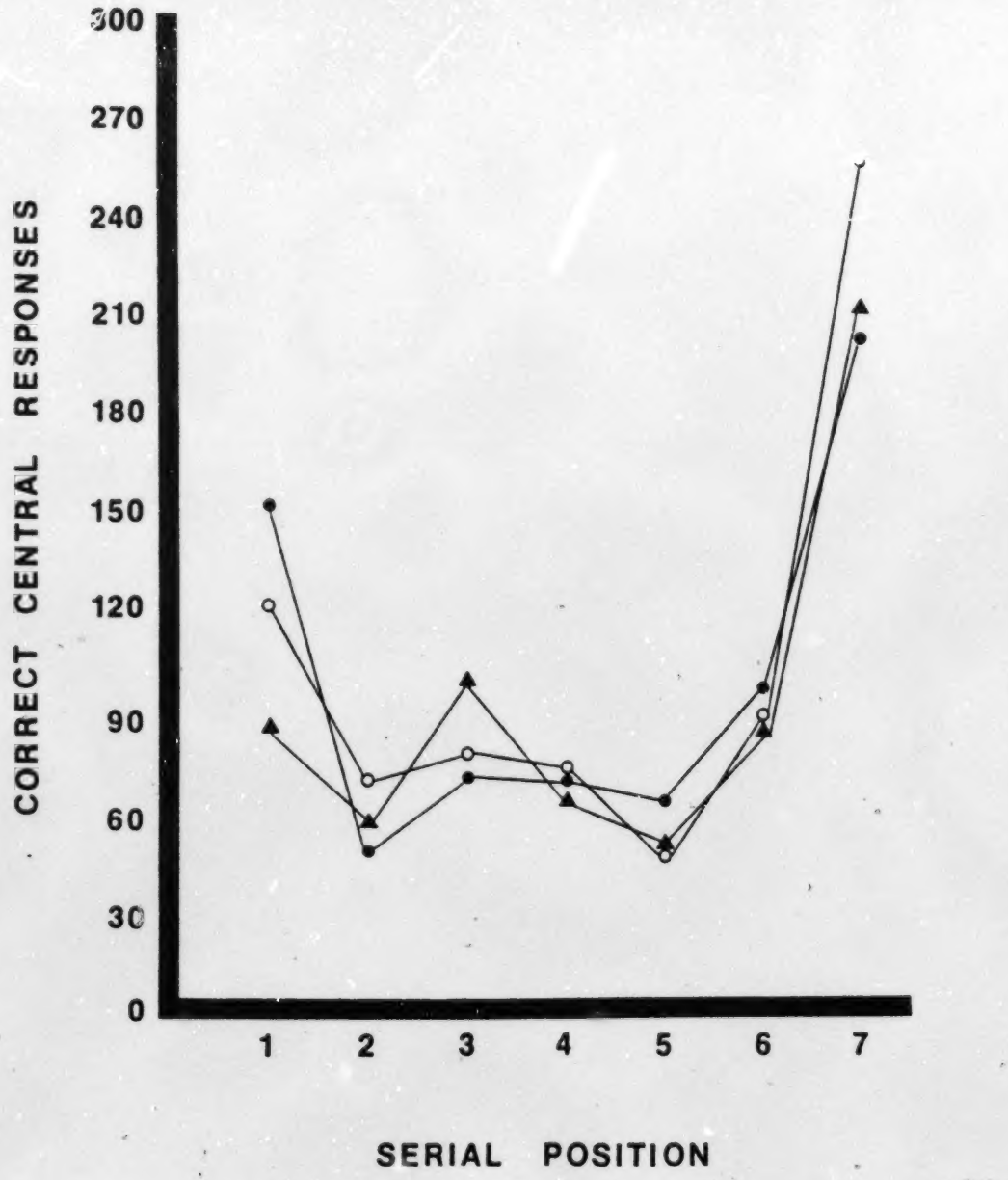

Figure 1. Proportion (arc sine transformation) of correct central responses at seven serial positions under subject-controlled (SC), 2-second (2S), and 6-second (6S) stimulus presentation rates.

was produced under the SC condition. The 2S condition produced a serial position curve very similar to that reported for learning disabled children under the 2-second standard administration procedure in earlier studies (Tarver et al., 1976; Tarver & Maggiore, 1979), thus validating the use of this standard condition as a control condition in this study.

Although the grade X condition X position interaction did not reach significance at the conventional .05 level [F (36,372) = 1.35, $p < .09$], a trend in the predicted direction is evidenced by the means reported in Table 1. The aforementioned condition X position effect (greater facilitation of primacy, but not recency, recall under the SC condition) is strongest at grade 7. This effect clearly did not occur at grade 1, though it was evident at grade 3, increased slightly at grade 5, and increased sharply at grade 7.

Stimulus Exposure Analysis

Stimulus exposure time (under the SC condition only) was analyzed in a grade X position X sex analysis of variance with repeated measures for the position factor. Significant effects were found for position [F (6,56) = 44.40, $p < .001$] and the position X grade interaction [F (18,336) = 1.97, $p < .05$]. Figure 2 shows the mean exposure times by serial position and grade (collapsed across sex).

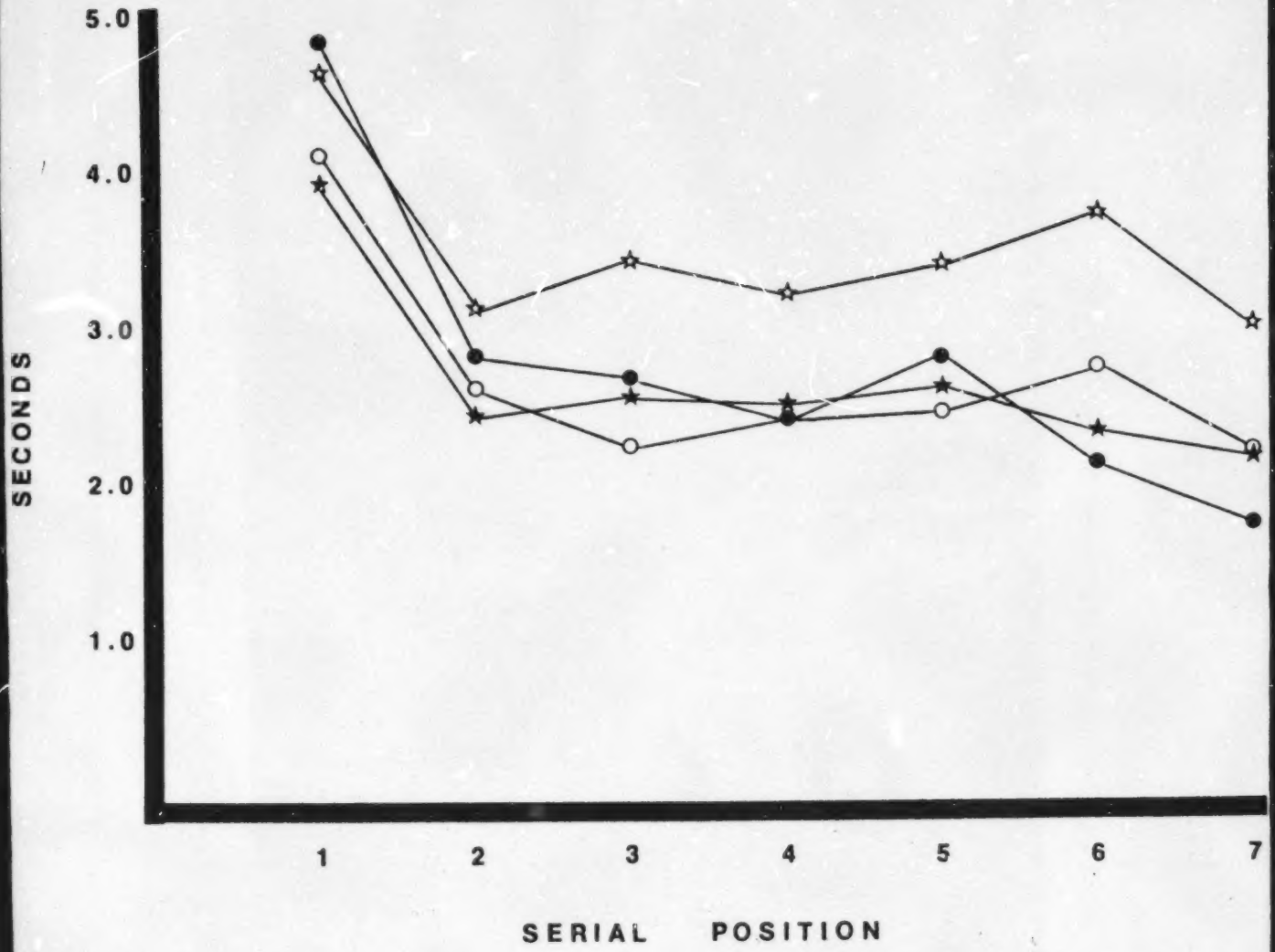

Figure 2. Stimulus exposure times at seven serial positions for four grades under a subject-controlled condition.

A Scheffe post hoc analysis ($\sigma = .05$) revealed a longer exposure time for position 1 than for any of the other 6 positions and a longer exposure time for position 5 than for position 7. The position X grade interaction was produced, in large part, by the performance pattern of grade 1 relative to that of the other three grades--a longer stimulus exposure at position 1 in combination with a shorter stimulus exposure at positions 6 and 7. The predicted stimulus exposure time pattern--increasingly longer exposure times across primacy and middle positions--did not occur at any of the four grade levels. Unexpectedly, all grades showed a longer exposure time at position 1.

Naming Speed Analysis

Naming speed was analyzed in a grade X sex analysis of variance. Again, no sex differences were found. A significant grade effect was found [F (3,56) = 5.16, $p < .01$]; the Scheffe analysis ($\sigma = .05$) revealed that naming time was longer at grade 1 than at any of the other grades and that grades 3, 5, and 7 did not differ. Mean naming times for grades 1, 3, 5, and 7 (17.5, 8.7, 7.7, and 7.1 seconds, respectively) indicate that the first graders took twice as long to name the animal pictures as did the children at the other grade levels.

Correlational Analysis

The naming speed measure was correlated with seven recall measures (total central recall across conditions and positions, SC-position 1, 6S-position 1, 2S-position 1, SC-position 7, 6S-position 7, 2S-position 7) and two stimulus exposure measures obtained under the SC condition only (exposure time-position 1, exposure time-position 7). Each of these 10 measures was also correlated with CA and IQ. Considering the number of correlations generated, surprisingly few were significant ($\sigma = .05$) and those few were moderate in magnitude. Naming speed was correlated with only one recall measure--2S-position 1 ($r = .35$, $p < .01$)--and that was in the opposite direction of that predicted (i.e., a longer naming time was predicted to be associated with lower primacy recall, thus yielding a negative correlation).

CA was correlated with naming speed ($r = -.41$, $p < .001$) and central recall ($r = .39$, $p < .001$) as predicted, indicating that naming became faster and central recall became greater with increasing age. In opposition to the predicted CA correlations were the rs of -.37 ($p < .05$) with 2S-position 1 and .31 ($p < .05$) with exposure time-position 7. IQ was not significantly correlated with any of the 10 measures.

Incidental Recall Analysis

Proportion of correct incidental responses (arc sine transformation) was analyzed in a grade X sex analysis of variance. No significant differences were found. This finding essentially replicates earlier studies reporting no significant changes in incidental recall performance across the age range investigated here (Dawson et al., 1979; Tarver et al., 1976; Tarver & Maggiore, 1979).

Discussion

The major hypotheses of this study were generally supported by the results of the serial recall analysis. The three stimulus presentation conditions affected primacy and recency recall differently; furthermore, recall differed by grade level. To summarize briefly, serial recall curves collapsed across grades revealed the following picture: (a) the SC condition, relative to both the 6S and 2S conditions, facilitated primacy but not recency recall; (b) the 6S condition, relative to the 2S condition, facilitated both primacy and recency recall; relative to the SC condition, however, this 6S condition produced less primacy, but greater recency recall; and (c) the standard 2S condition produced a recency, but not a primacy effect. Although this performance pattern did not occur at grade 1, it became increasingly evident at the higher grade levels. At grade 1, the slower presentation rate (6S), relative to the SC condition, pro-

duced greater primacy recall. At grade 3, however, a slight difference in favor of the SC condition occurred and the SC superiority became increasingly greater at grades 5 and 7. This latter finding supports the hypothesis that the learning disabled subjects, with increasing age, were increasingly able to utilize the opportunity to control stimulus exposure time to achieve an efficient match between individual speed of naming and stimulus exposure time.

The naming speed analysis provided further support for the hypothesis that this variable plays an important role in primacy recall. The findings for first graders--that they required twice as much time as the older children to name the animal pictures and that their primacy recall benefited from a slower stimulus presentation rate which allowed more time for retrieval and rehearsal of the animal names--suggest that naming speed is particularly important at this age level. At the higher grades, faster naming occurred in conjunction with improved primacy recall under the SC, relative to the 6S, condition. Performance differences between first and third graders indicate that the learning disabled acquired the ability to name rapidly in the interim between school entrance and third grade and that they were subsequently able to use more sophisticated and efficient verbal rehearsal strategies. This developmental pattern suggests that the acquisition of rapid naming skill is prerequisite to the application of more advanced verbal mnemonic strategies in the learning disabled population, as is the case in the nondisabled population (Chi, 1977).

Two major cross-cultural studies support the contention that normal developmental increases in the application of remembering strategies are, to a large extent, a function of schooling (Kagan, Klein, Finley, Rogoff, & Nolan, 1979; Sharp, Cole, & Lave, 1979). The typical school day involves numerous naming activities (e.g., naming letters, numerals, pictures, etc.). Participation in a variety of naming activities may promote the development of a general naming ability, which, in turn, may contribute to the further development of cognitive abilities such as short-term memory as well as to the acquisition of specific academic skills (e.g., reading decoding skills). The automatic information processing theory of LaBerge and Samuels (1974) posits that the automatic decoding of written symbols into their spoken counterparts (in a sense, labeling graphemes with associated phonemes) is prerequisite to the acquisition of higher level reading comprehension skills and that automaticity is indicated by speed. It may be, then, that beginning reading programs which emphasize the overlearning of grapheme-phoneme associations to the point of automaticity (i.e., rapid naming) also serendipitously contribute to general cognitive functioning.

Correlations among primacy recall, naming speed, and CA yielded equivocal findings. Although CA was moderately correlated with naming speed and overall central recall in the predicted directions, naming speed and primacy recall were not correlated as predicted. In

either case, these correlational findings should be interpreted cautiously because of a methodological limitation inherent in the design of the study--restriction of the range of the data by the restriction of age ranges within particular grade levels. Nonetheless, the low to moderate magnitude of the correlations suggest that factors other than CA and naming speed may also contribute to primacy recall. IQ was not implicated as a contributing factor as it was related to neither the naming speed nor the serial recall measures. Nor was sex implicated; no sex differences were found.

Analysis of the subject-controlled stimulus exposure times by serial position resulted in unexpected findings which suggest that orienting response may have been one uninvestigated factor which played an important role in primacy recall. The predicted serial position curve for exposure times did not occur at any grade level; instead, a longer exposure time at position 1 was evident at all grades. This longer response latency at position 1 suggests that the children may have required an unexpectedly long time at the initiation of each trial to become oriented to the task. Under the SC condition, unlimited orientation time is available; in contrast, under the 2S presentation rate, the subject must become oriented to each trial very quickly in order to process the first stimulus item. A slow orienting response could, therefore, account for inferior recall at position 1 under fast presentation rates. This interpretation could explain an unexpected finding reported in several earlier

studies under the standard 2-second presentation rate--slightly higher recall at position 2 than at position 1 (Dawson et al., 1979; Tarver et al., 1976; Tarver & Maggiore, 1979). It is also consistent with the finding that participation in an orienting task increased the free recall performance of learning disabled children (Torgeson, Murphy, & Ivey, 1979).

Previous studies have documented the effectiveness of verbal rehearsal instructions (Tarver et al., 1976), incentives (Haines & Torgeson, 1979), and a combination of verbal rehearsal instructions and reinforcement (Dawson et al., 1979) in improving the verbal rehearsal of learning disabled children. The study reported here adds to this list subject control of stimulus exposure times. This condition clearly facilitated primacy recall in the absence of either verbal instructions or external reinforcement. The data suggest that the improved performance under this condition was due to the provision of adequate time for retrieval and rehearsal of the stimulus names, in combination with the provision of additional time to become oriented to the task at the beginning of each trial.

References

Bauer, R. H. Memory processes in children with learning disabilities: Evidence for deficient rehearsal. Journal of Experimental Child Psychology, 1977, 24, 415-430. (a)

Bauer, R. H. Short-term memory in learning disabled and nondisabled children. Bulletin of the Psychonomic Society, 1977, 10, 128-130. (b)

Belmont, J. M., & Butterfield, E. C. What the development of short-term memory is. Human Development, 1971, 14, 236-248.

Butterfield, E. C., & Belmont, J. M. The role of verbal processes in short-term memory. In R. L. Schiefelbusch (Ed.), Language of the mentally retarded. Baltimore: University Park Press, 1972.

Chi, M. T. H. Age differences in memory span. Journal of Experimental Child Psychology, 1977, 23, 266-281.

Dawson, M. M., Hallahan, D. P., Reeve, R. E., & Ball, D. W. The effect of reinforcement and verbal rehearsal on selective attention in learning disabled children. Journal of Abnormal Child Psychology, 1979, in press.

Denckla, M., & Rudel, R. Rapid "automatized" naming (R.A.N.): Dyslexia differentiated from other learning disabilities. Neuropsychologia, 1976, 14, 471-479.

Detterman, D. K. Primacy effects in short-term memory with the mentally retarded. Child Development, 1974, 45, 1077-1082.

Donaldson, M., & Strang, H. Primacy effect in short-term memory in young children. Psychonomic Science, 1969, 16, 59-60.

Dunn, L. M. (Ed.). Exceptional children in the schools. New York: Holt, Rinehart and Winston, 1963.

Ellis, N. R. Memory processes in retardates and normals. In N. R. Ellis (Ed.), International review of research in mental retardation (Vol. 4). New York: Academic Press, 1970.

German, D. J. N. Word-finding skills in children with learning disabilities. Journal of Learning Disabilities, 1979, 12, 176-181.

Hagen, J. W. The effect of distraction on selective attention. Child Development, 1967, 38, 685-694.

Haines, D. J., & Torgesen, J. K. The effects of incentives on rehearsal and short-term memory in children with reading problems. Learning Disability Quarterly, 1979, 2(2), 48-55.

Kagan, J., Klein, R. E., Finley, G. E., Rogoff, B., & Nolan, E. A cross-cultural study of cognitive development. Monographs of the Society for Research in Child Development, 1979, 44(5, Serial No. 180).

Kail, R. V., & Seigel, A. W. Sex differences in retention of verbal and spatial characteristics of stimuli. Journal of Experimental Child Psychology, 1977, 23, 341-347.

LaBerge, D., & Samuels, S. J. Toward a theory of automatic information processing in reading. Cognitive Psychology, 1974, 6, 293-323.

McGrady, H. J., & Olson, D. A. Visual and auditory learning processes in normal children and children with specific learning disabilities. Exceptional Children, 1970, 36, 581-589.

Naus, M. J., Ornstein, P. A., & Aivano, S. Developmental changes in memory: The effects of processing time and rehearsal instructions. Journal of Experimental Child Psychology, 1977, 23, 237-251.

Pelham, W. E., & Ross, A. O. Selective attention in children with reading problems: A developmental study of incidental learning. Journal of Abnormal Child Psychology, 1977, 5, 1-8.

Sharp, D., Cole, M., & Lave, C. Education and cognitive development: The evidence from experimental research. Monographs of the Society for Research in Child Development, 1979, 44(1-2, Serial No. 178).

Swanson, H. L. Nonverbal visual short-term memory as a function of age and dimensionality in learning-disabled children. Child Development, 1977, 48, 51-55.

Tarver, S. G., Hallahan, D. P., Kauffman, J. M., & Ball, D. W. Verbal rehearsal and selective attention in children with learning disabilities: A developmental lag. Journal of Experimental Child Psychology, 1976, 22, 375-385.

Tarver, S. G., & Maggiore, R. P. Cognitive development in learning disabled boys. Learning Disability Quarterly, 1979, 2(3), 78-84.

Torgesen, J. K., & Goldman, T. Verbal rehearsal and short-term memory in reading disabled children. Child Development, 1977, 48, 56-60.

Torgesen, J. K., Murphy, H. A., & Ivey, C. The influence of an orienting task on the memory performance of children with reading problems. Journal of Learning Disabilities, 1979, 12, 396-401.

Wiig, E. H., & Semel, E. M. Productive language abilities in learning disabled adolescents. Journal of Learning Disabilities, 1975, 8, 578-586.

Center Planning and Policy Committee

Richard A. Rossmiller
Wayne Otto
Center Co-Directors

Dale D. Johnson
Area Chairperson
Studies in Language:
Reading and Communication

Marvin J. Fruth
Area Chairperson
Studies in Implementation
of Individualized Schooling

Penelope L. Peterson
Area Chairperson
Studies of Instructional Programming
for the Individual Student

James M. Lipham
Area Chairperson
Studies of Administration and
Organization for Instruction

Thomas A. Romberg
Area Chairperson
Studies in Mathematics and Evaluation
of Practices in Individualized Schooling

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Psychology

B. Dean Bowles
Professor
Educational Administration

Thomas P. Carpenter
Associate Professor
Curriculum and Instruction

W. Patrick Dickson
Assistant Professor
Child and Family Studies

Lloyd E. Frohreich
Associate Professor
Educational Administration

Marvin J. Fruth
Professor
Educational Administration

Dale D. Johnson
Professor
Curriculum and Instruction

Herbert J. Klausmeier
V.A.C. Henmon Professor
Educational Psychology

Joel R. Levin
Professor
Educational Psychology

James M. Lipham
Professor
Educational Administration

Dominic W. Massaro
Professor
Psychology

Donald M. McIsaac
Professor
Educational Administration

Wayne Otto
Professor
Curriculum and Instruction

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Assistant Professor
Educational Psychology

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Professor
Curriculum and Instruction

Gary G. Price
Assistant Professor
Curriculum and Instruction

W. Charles Read
Professor
English and Linguistics

Thomas A. Romberg
Professor
Curriculum and Instruction

Richard A. Rossmiller
Professor
Educational Administration

Peter A. Schreiber
Associate Professor
English and Linguistics

B. Robert Tabachnick
Professor
Curriculum and Instruction

Gary G. Wehlage
Professor
Curriculum and Instruction

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Associate Professor
Educational Psychology

Steven R. Yussen
Professor
Educational Psychology

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